CLAIMS

WHAT IS CLAIMED IS:

1. A method of measuring continuity of a data set, the method comprising:

obtaining a vector set from the data set;

combining vectors from the vector set to determine a representative vector for the vector set; and

calculating a continuity measurement for the vector set.

2. The method of claim 1, wherein said calculating a continuity measurement includes:

finding for each vector in the vector set a projection value indicative of a projection of the vector along a line of similarity defined by the representative vector.

3. The method of claim 2, wherein said calculating a continuity measurement further includes:

summing squares of the projection values to obtain a sum of projection squares.

4. The method of claim 3, wherein said calculating a continuity measurement further includes:

normalizing the sum of projection squares to obtain the continuity measurement for the vector set.

5. The method of claim 4, wherein the continuity measurement is expressible as:

$C = \frac{\sum_i \beta_i^2}{\sum_i E_i}$, wherein C represents the continuity measurement, β_i represents the projection value for vector i, E_i represents an energy of vector i, and i represents an index that ranges over the vector set.

6. The method of claim 2, wherein said calculating a continuity measurement further includes:

normalizing a square of the projection value for each vector in the vector set; and

averaging the normalized squares of projection values to obtain the continuity measurement for the vector set.

7. The method of claim 6, wherein the continuity measurement is expressible as:

$C = \frac{1}{N}\sum_{i=1}^{N}\frac{\beta_i^2}{E_i}$, wherein C represents the continuity measurement, β_i represents the projection value for vector i, E_i represents an energy of vector i, i represents an index that ranges over the vector set, and N represents a number of vectors in the vector set.

8. The method of claim 1, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

summing the vectors in the vector set.

9. The method of claim 8, wherein said combining vectors from the vector set to determine a representative vector from the vector set further includes:

dividing a sum of the vectors in the vector set to obtain an average vector.

10. The method of claim 1, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

determining a weighted sum of the vectors in the vector set.

11. The method of claim 1, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

determining the representative vector to be that vector that minimizes a total distance measurement between the representative vector and each of the vectors in the set.

12. The method of claim 11, wherein the total distance measurement combines Manhattan distance measurements from the representative vector to each of the vectors in the set.

13. The method of claim 1, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

training a neural network on the vector set.

14. The method of claim 13, wherein the neural network is a single-neuron network that iteratively updates a weight vector using a Hebbian-learning rule.

15. The method of claim 1, further comprising:

repeating said obtaining, combining, and calculating to obtain a set of continuity measurements each having an associated spatial position.

16. The method of claim 1, further comprising:

displaying the set of continuity measurements as a function of spatial position.

17. The method of claim 1, wherein the data set is derived from a seismic survey.

18. A method of measuring continuity of a data set, the method comprising:

obtaining a vector set from the data set;

determining a representative vector for the vector set; and

calculating a continuity measurement for the vector set, wherein said calculating includes:

finding for each vector in the vector set a projection value indicative of a projection of the vector along a line defined by the representative vector.

19. The method of claim 18, wherein said calculating a continuity measurement further includes:

summing squares of the projection values to obtain a sum of projection squares.

20. The method of claim 19, wherein said calculating a continuity measurement further includes:

normalizing the sum of projection squares to obtain the continuity measurement for the vector set.

21. The method of claim 18, wherein said calculating a continuity measurement further includes:

normalizing a square of the projection value for each vector in the vector set; and

averaging the normalized squares of projection values to obtain the continuity measurement for the vector set.

22. The method of claim 18, wherein the data set is derived from a seismic survey.

23. A method of measuring discontinuity of a data set, the method comprising:

obtaining a vector set from the data set;

combining vectors from the vector set to determine a representative vector for the vector set; and calculating a discontinuity measurement for the vector set.

24. The method of claim 23, wherein said calculating a discontinuity measurement includes:

finding for each vector in the vector set a projection value indicative of a projection of the vector perpendicular to a line defined by the representative vector.

25. The method of claim 24, wherein said calculating a discontinuity measurement includes:

summing squares of projection values determined relative to the representative vector to obtain a sum of projection squares.

26. The method of claim 23, wherein said calculating a discontinuity measurement includes:

normalizing a square of a projection value for each vector in the vector set; and

averaging the normalized squares of projection values to obtain the discontinuity measurement for the vector set.

27. The method of claim 26, wherein the discontinuity measurement is expressible as:

$D = \frac{\sum_i \varepsilon_i^2}{\sum_i E_i}$, wherein D represents the discontinuity measurement, ε_i represents the projection value for vector i, E_i represents an energy of vector i, and i represents an index that ranges over the vector set.

28. The method of claim 24, wherein said calculating a discontinuity measurement further includes:

normalizing a square of the projection value for each vector in the vector set; and

averaging the normalized squares of projection values to obtain the discontinuity measurement for the vector set.

29. The method of claim 28, wherein the discontinuity measurement is expressible as:

$D = \frac{1}{N}\sum_{i=1}^{N}\frac{\varepsilon_i^2}{E_i}$, wherein D represents the discontinuity measurement, ε_i represents the projection value for vector i, E_i represents an energy of vector i, i represents an index that ranges over the vector set, and N represents a number of vectors in the vector set.

30. The method of claim 23, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

summing the vectors in the vector set.

31. The method of claim 30, wherein said combining vectors from the vector set to determine a representative vector from the vector set further includes:

dividing a sum of the vectors in the vector set to obtain an average vector.

32. The method of claim 23, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

determining a weighted sum of the vectors in the vector set.

33. The method of claim 23, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

determining the representative vector to be that vector that minimizes a total distance measurement between the representative vector and each of the vectors in the set.

34. The method of claim 33, wherein the total distance measurement combines Manhattan distance measurements from the representative vector to each of the vectors in the set.

35. The method of claim 23, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

training a neural network on the vector set.

36. The method of claim 35, wherein the neural network is a single-neuron network that iteratively updates a weight vector using a Hebbian-learning rule.

37. The method of claim 23, further comprising:

repeating said obtaining, combining, and calculating to obtain a set of continuity measurements each having an associated spatial position.

38. The method of claim 23, further comprising:

displaying the set of continuity measurements as a function of spatial position.

39. The method of claim 38, wherein the data set is derived from a seismic survey.

40. A method of measuring discontinuity of a data set, the method comprising:

obtaining a vector set from the data set;

determining a representative vector for the vector set; and

calculating a discontinuity measurement for the vector set, wherein said calculating includes:

finding for each vector in the vector set a projection value indicative of a projection of the vector perpendicular to a line defined by the representative vector.

41. The method of claim 40, wherein said calculating a discontinuity measurement further includes:

summing squares of the projection values to obtain a sum of projection squares.

42. The method of claim 41, wherein said calculating a discontinuity measurement further includes:

normalizing the sum of projection squares to obtain the discontinuity measurement for the vector set.

43. The method of claim 40, wherein said calculating a discontinuity measurement further includes:

normalizing a square of the projection value for each vector in the vector set; and

averaging the normalized squares of projection values to obtain the discontinuity measurement for the vector set.

44. The method of claim 40, wherein the data set is derived from a seismic survey.

45. A method of seismic exploration that comprises:

detecting seismic energy with an array of detectors;

converting detection signals from the array of detectors into data representing one or more attributes as a function of position for subsurface formations;

systematically obtaining subsets of the data as vector sets; and

for each vector set:

combining vectors from the vector set to determine a representative vector for the vector set; and

calculating a continuity or discontinuity measurement with respect to the representative vector.

46. The method of claim 45, further comprising:

displaying the continuity or discontinuity measurement as a function of position.

47. The method of claim 46, wherein said displaying includes:

providing a two-dimensional map with the continuity or discontinuity measurement indicated by color or intensity.

48. The method of claim 46, wherein said displaying includes:

providing a view in which the continuity or discontinuity measurements are shown as a function of three spatial dimensions.

49. The method of claim 45, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

summing the vectors in the vector set.

50. The method of claim 49, wherein said combining vectors from the vector set to determine a representative vector from the vector set further includes:

dividing a sum of the vectors in the vector set to obtain an average vector.

51. The method of claim 45, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

determining a weighted sum of the vectors in the vector set.

52. The method of claim 45, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

determining the representative vector to be that vector that minimizes a total distance measurement between the representative vector and each of the vectors in the set.

53. The method of claim 52, wherein the total distance measurement combines Manhattan distance measurements from the representative vector to each of the vectors in the set.

54. The method of claim 45, wherein said combining vectors from the vector set to determine a representative vector for the vector set includes:

training a neural network on the vector set.

55. The method of claim 54, wherein the neural network is a single-neuron network that iteratively updates a weight vector using a Hebbian-learning rule.

56. A seismic survey system comprising:

a data storage device that stores seismic measurements;

a processor that retrieves said seismic measurements as one or more vector sets and combines vectors from at least one of the vector sets to determine a representative vector, wherein said processor calculates a continuity or discontinuity measurement with respect to the representative vector.

57. The system of claim 56, wherein the processor combines vectors to determine a representative vector by summing the vectors in said at least one of the vector sets.

58. The system of claim 57, wherein the processor determines the representative vector by further dividing a sum of the vectors in said at least one of the vector sets to obtain an average vector.

59. The system of claim 56, wherein the processor combines vectors to determine the representative vector by determining a weighted sum of the vectors in said at least one of the vector sets.

60. The system of claim 56, wherein the processor combines vectors to determine the representative vector by determining the representative vector to be that vector that minimizes a

total distance measurement between the representative vector and each of the vectors in said at least one of the vector sets.

61. The system of claim 60, wherein the total distance measurement combines Manhattan distance measurements from the representative vector to each of the vectors in said at least one of the vector sets.

62. The method of claim 56, wherein the processor combines vectors to determine the representative vector by training a neural network on said at least one of the vector sets.

63. The system of claim 62, wherein the neural network is a single-neuron network that iteratively updates a weight vector using a Hebbian-learning rule.

64. The system of claim 56 further comprising a display for the continuity or discontinuity measurements.

65. A method of seismic exploration that comprises:

detecting seismic energy with an array of detectors;

converting detection signals from the array of detectors into data representing one or more attributes as a function of position for subsurface formations;

systematically obtaining subsets of the data as vector sets; and

for each vector set:

averaging vectors from the vector set to determine a representative vector for the vector set;

calculating a continuity or discontinuity measurement with respect to the representative vector; and

providing a display with the continuity or discontinuity measurement indicated by color intensity.